Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D. C. 20554

FCC 96-80

In the Matter of	)	
	)	
Amendment of Parts 74, 78, and 101	)	
of the Commission's Rules to Adopt More	)	ET Docket No. 96-35
Flexible Standards for Directional	)	
Microwave Antennas	)	

NOTICE OF PROPOSED RULE MAKING

Adopted: February 29, 1996 ; Released: March 14, 1996

Comment Date: April 26, 1996
Reply Comment Date: May 13, 1996

By the Commission:

INTRODUCTION

1. By this action, we propose to modify our fixed service microwave rules to make them compatible with new, emerging technologies for directional antennas. We believe that the proposed changes will preserve the intent of the rules to maximize spectrum efficiency and minimize interference. Specifically, rather than requiring a showing of minimum antenna gain, we propose to permit an alternative showing that such antennas comply with a maximum beamwidth requirement. This alternative will remove a regulatory impediment to the use by Commission licensees of directional antennas employing new emerging technologies for which, in contrast to conventional antennas, maximum antenna beamwidth is not correlated directly to minimum antenna gain.

BACKGROUND

2. In order to maximize spectrum efficiency and minimize interference, our rules for fixed microwave antennas specify various technical requirements designed to control the radiation pattern of directional antenna emissions.[1] The intent of these rules was to limit the beamwidth of point-to-point links, thus allowing more point-to-point use in the same spectrum

[1] These rules are codified at Sections 74.536, 74.641, 78.105, and 101.115 of the Commission's Rules.

in a given area. For many frequency bands, our rules limit beamwidth by specifying mandatory minimum acceptable antenna gain requirements.

3. A directional antenna focuses radio power into a narrower beam than does an omnidirectional antenna. This focusing limits the radiation of power in unintended directions and thus facilitates frequency reuse. Such directionalization results in a higher effective isotropic radiated power ("EIRP") in the direction of focus of the antenna than is provided in any direction by an omnidirectional antenna operating with similar input power. The EIRP in other directions is smaller for directional antennas than for omnidirectional antennas of similar input power. One way to measure the directionality of an antenna is to measure the beamwidth of the radiated power directly. However, this direct measurement is technically difficult to perform. An easier measurement is the antenna gain, i.e., the strength of the radiated power in the center of the beam. In conventional antennas, these two parameters are correlated: high antenna gain is always paired with low beamwidth antenna designs,[2] so that the gain can be mathematically derived from the beamwidth and vice versa.

4. Recent technological developments have made alternative directional antenna designs available. One of these technologies, planar arrays, spreads the power over a large number of radiating elements in a flat plane in order to achieve a narrow beamwidth. Such antennas must split the input power several times in order to feed it to the multiple radiating elements. This multiple power splitting results in inevitable power losses which, in turn, limit the achievable antenna gain.[3] Thus, while such directional antennas can achieve sufficiently narrow beamwidths to comply with the intent of our rules, they cannot comply with the present rule, which literally requires a specific minimum antenna gain. These technical developments have prompted this notice.

DISCUSSION

5. The frequency bands listed in Sections 74.536, 74.641, 78.105, and 101.115 can be divided into three groups: those bands with maximum beamwidth and minimum antenna gain requirements,[4] those bands with only a maximum beamwidth requirement,[5] and those bands

---

[2] Horn and dish antennas are the most common types of traditional directional antennas.

[3] While this explanation deals with transmitting antennas, receiving antennas have similar losses which limit the achievable gain.

[4] In §§ 74.536, 74.641, 78.105, and 101.115, this band is 31,000 - 31,300 MHz. Additionally, the 10,550 - 10,680 MHz band (for point-to-point stations authorized on or before June 1, 1997) in § 101.115 has both parameters listed.

with only a minimum antenna gain requirement. We are not proposing any changes for the first two groups because we believe the existing rules are adequate. Specifically, the existing beamwidth requirements have been in place for many years without any complaints of harmful interference. Additionally, while in the past we have regulated antenna gain as a proxy for beamwidth, in this proceeding we focus on the key factor in minimizing harmful interference -- maximum beamwidth. Accordingly, we limit our proposal to those bands that currently have only a minimum antenna gain requirement. In Sections 74.536 and 74.641, this band is 17,700 - 19,700 MHz. In Section 78.105, these bands are 17,700 - 19,700 MHz and 38,600 - 40,000 MHz. In Section 101.115, these bands are 3,700 - 4,200 MHz, 5,925 - 6,425 MHz, 6,525 - 6,875 MHz (for point-to-point stations authorized after June 1, 1997), 10,550 - 10,680 MHz (for point-to-point stations authorized after June 1, 1997), 10,700 - 11,700 MHz, 17,700 - 18,820 MHz, 18,920 - 19,700 MHz, 21,200 - 23,600 MHz, and frequencies above 31,300 MHz.

6. Specifically, we propose to amend Sections 74.536, 74.641, 78.105, and 101.115 of the Commission's Rules to allow directional antennas to comply with requirements for either minimum antenna gain or maximum beamwidth. We do not propose to change any of the existing requirements with respect to sidelobe suppression[6] because we believe that these requirements, which are designed to reduce potential interference, can readily be met by both conventional and new antenna technologies. We propose to convert the present antenna gain requirements to the comparable requirements for antenna beamwidths[7] based on two assumptions: (1) a parabolic ("dish") antenna with an efficiency of 55% is used as a reference; and (2) the illumination function taper value is 70. Table I depicts the existing gain requirements and the new corresponding beamwidth requirements for bands that do not have an existing maximum beamwidth option:

---

[5] In § 74.641, these bands are 1,900 - 2,110 MHz, 6,875 - 7,125 MHz, and 12,700 - 13,250 MHz. In § 78.105, this band is 12,700 - 13,250 MHz. In § 101.115, these bands are 932.5 - 935 MHz, 941.5 - 944 MHz, 952 - 960 MHz, 1,850 - 2,500 MHz, 6,525 - 6,875 MHz (for point-to-point stations authorized on or before June 1, 1997), 10,565 - 10,615 MHz, and 12,200 - 13,250 MHz.

[6] Sidelobe suppression deals with limiting the emissions in directions far away from the intended directions.

[7] See J.D. Kraus, Antennas, 2nd Ed., McGraw-Hill, 1988.

Table I. Antenna Gain and Equivalent Beamwidths	
Gain (dBi)	Equivalent Beamwidth (degrees)
34	3.5
36	2.7
38	2.2

This technical equivalency is independent of the frequency bands.

7. Appendix B shows the proposed changes to Section 101.115. We propose to make the same changes to the corresponding rows in the tables in Sections 74.536, 74.641 and 78.105, which are subsets of the table given in Section 101.115.

8. We note that these new types of antennas may differ somewhat from conventional antennas in the exact shape of the mainlobe.[8] Thus, even with sidelobe suppression required by the present rules, the beam shape for a planar array antenna may be different than for a dish antenna. While we do not believe that these differences would have a significant impact on spectrum efficiency, we seek comment on whether such differences might have an impact on coordination. We propose to address this problem by requiring the coordination process to treat all antennas as if they had the mainlobe shape and total gain of a conventional parabolic dish antenna. However, we invite comments on this approach, and encourage alternative proposals.

CONCLUSION

9. By this action, we propose to modify our fixed service microwave rules to make them more compatible with certain new, emerging technologies for directional antennas. Specifically, we propose to permit alternative showings that such antennas comply with maximum beamwidth requirements rather than requirements for minimum antenna gains. We believe that these proposed changes will preserve the intent of the rules to maximize spectrum efficiency and minimize interference. At the same time, such changes will provide Commission licensees with additional flexibility to use directional antennas employing new

[8] For example, in a planar array antenna the spatial distribution of radiating elements changes the electrical current distribution of the antenna. By changing this current distribution, the designer can alter the shape of the mainlobe. By contrast, designers of the conventional dish or horn antennas have less flexibility in changing the current distribution. Hence, despite variations in antenna beamwidth and gain, most dish and horn antenna designs have a similar basic mainlobe shape.

emerging technologies for which, in contrast to conventional antennas, maximum antenna beamwidth is not correlated directly with minimum antenna gain.

PROCEDURAL MATTERS

10. Ex parte Presentation. This is a non-restricted notice and comment rule making proceeding. Ex parte presentations are permitted, except during the Sunshine Agenda period,provided they are disclosed as provided in the Commission's Rules. See generally 47 C.F.R. Sections 1.1202, 1.1203, and 1.1206(a).

11. Initial Regulatory Flexibility Analysis. As required by Section 603 of the Regulatory Flexibility Act, the Commission has prepared an Initial Regulatory Flexibility Analysis (IRFA) of the expected impact on small entities of the proposals suggested in this document. The IRFA is set forth in Appendix A. Written public comments are requested on the IRFA. These comments must be filed in accordance with the same filing deadlines as comments on the rest of the Notice, but they must have a separate and distinct heading designating them as responses to the Initial Regulatory Flexibility Analysis. The Secretary shall send a copy of this Notice of Proposed Rule Making, including the Initial Regulatory Flexibility Analysis, to the Chief Counsel for Advocacy of the Small Business Administration in accordance with paragraph 603(a) of the Regulatory Flexibility Act. Pub. L. No. 96-354, 94 Stat. 1164, 5 U.S.C. Section 601 et seq. (1981).

12. Comment Dates. Pursuant to applicable procedures set forth in Sections 1.415 and 1.419 of the Commission's Rules, 47 C.F.R. Sections 1.415 and 1.419, interested parties may file comments on or before **April 26, 1996** and reply comments on or before **May 13, 1996**. To file formally in this proceeding, you must file an original and four copies of all comments, reply comments, and supporting comments. If you want each Commissioner to receive a personal copy of your comments, you must file an original plus nine copies. You should send comments and reply comments to Office of the Secretary, Federal Communications Commission, Washington, D.C. 20554. Comments and reply comments will be available for public inspection during regular business hours in the FCC Reference Center, Room 239, 1919 M Street, N.W., Washington, D.C. 20554.

13. Authority. The proposed action is authorized under Sections 4(i), 302, 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended 47 U.S.C. Sections 154(i), 302, 303(e), 303(f), and 303(r).

14. For further information regarding this Notice of Proposed Rule Making, please either send an electronic mail message via the Internet to mmarcus@fcc.gov or telephone Dr. Michael J. Marcus, Office of Engineering and Technology, (202) 418-2418.

FEDERAL COMMUNICATIONS COMMISSION

William F. Caton
Acting Secretary

APPENDIX A - INITIAL REGULATORY FLEXIBILITY ANALYSIS

I. Reason for Action: The proposals in this Notice of Proposed Rule Making are put forth on our own initiative with the intention of permitting microwaves users more flexibility in selecting antennas for their systems.

II. Objective: The objective of this proposal is to minimize unnecessary regulatory burdens on microwave users and manufacturers.

III. Legal Basis: The proposed action is authorized under Sections 4(i), 302, 303(e), 303(f), and 303(r) of the Communications Act of 1934, as amended 47 U.S.C. Sections 154(i), 302, 303(e), 303(f), and 303(r).

IV. Reporting, Record Keeping and Other Compliance Requirements: No new requirements are involved. Applicants will be afforded the option of complying with a standard for maximum antenna beamwidth as an alternative to complying with the existing requirement for minimum antenna gain.

V. Federal Rules Which Overlap, Duplicate or Conflict With These Rules: None.

VI. Description, Potential Impact and Number of Small Entities Involved: It is unknown how many small entities may be affected. It is thought that all entities affected by the proposed change will benefit from this action which allows more flexibility.

VII. Any Significant Alternatives Minimizing the Impact on Small Entities Consistent with Stated Objectives: None.

APPENDIX B - PROPOSED RULE CHANGES

Part 101 of title 47 of the Code of Federal Regulations is proposed to be amended as follows:

PART 101 -- FIXED MICROWAVE SERVICES

1. The authority citation for Part 101 continues to read as follows:

AUTHORITY: 47 U.S.C. §§ 154(i), 303, unless otherwise noted.

2. The Antenna Standards Table in paragraph 101.115(c) is amended as follows:

a. Remove existing entries from Column 3.

b. Add new entries to Column 3.

c. The Note following the Table is revised.

§101.115 Directional Antenna Standards Table

* * * * *

Antenna Standards

Frequency (MHz)	Category	Maximum beamwidth to 3 dB points (included angle in degrees)	Minimum antenna gain (dbi)	Minimum radiation suppression to angle in degrees from centerline of main beam in decibels						
				5° to 10°	10° to 15°	15° to 20°	20° to 30°	30° to 100°	100° to 140°	140° to 180°
932.5 to 935	A	14.0	n/a	. . .	6	11	14	17	20	24
	B	20.0	n/a	. . .	. . .	6	10	13	15	20
941.5 to 944	A	14.0	n/a	. . .	6	11	14	17	20	24
	B	20.0	n/a	. . .	. . .	6	10	13	15	20
952 to 960 (8)(9)	A	14.0	n/a	. . .	6	11	14	17	20	24
	B	20.0	n/a	. . .	. . .	6	10	13	15	20
1,850 to 2,500 (11)	A	5.0	n/a	12	18	22	25	29	33	39
	B	8.0	n/a	5	18	20	20	25	28	36
3,700 to 4,200	A	2.7	36	23	29	33	36	42	55	55
	B	2.7	36	20	24	28	32	32	32	32
5,925 to 6,425 (5)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
5,925 to 6,425 (6)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
6,525 to 6,875 (5)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	21	25	29	32	35	39	45
6,525 to 6,875 (6)	A	1.5	n/a	26	29	32	34	38	41	49
	B	2.0	n/a	21	25	29	32	35	39	45
10,550 to 10,680 (4)(5)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	35	39
10,550 to 10,680 (6)	A	3.4	34	20	24	28	32	35	55	55
	B	3.4	34	20	24	28	32	35	35	39
10,565 to 10,615 (7)	n/a	360	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
10,630 to 10,680 (7)	n/a	3.5	34	20	24	28	32	35	36	36
10,700 to 11,700 (5)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
12,200 to 13,250 (12)	A	1.0	n/a	23	28	35	39	41	42	50
	B	2.0	n/a	20	25	28	30	32	37	47
17,700 to 18,820	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
18,920 to 19,700 (1)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
21,200 to 23,600 (10)	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36
31,000 to 31,300 (2)(3)	n/a	4.0	38	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Above 31,300	A	2.2	38	25	29	33	36	42	55	55
	B	2.2	38	20	24	28	32	35	36	36

* * * * *

NOTE: Stations must employ an antenna that meets the performance standards for Category A, except that in areas not subject to frequency congestion, antennas meeting standards for Category B may be employed. Note, however, that the Commission may require the use of high performance antennas where interference problems can be resolved by the use of such antennas. For rows in the table in which both minimum gain and maximum beamwidth are indicated, licensees only have to show compliance with one of the two parameters.